

Birds of *kerangas*, converted lands, mixed dipterocarp and riparian forests in Central and East Kalimantan, Indonesia

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We present the results of bird surveys conducted in 2000 and 2006 at 13 sites in the interior lowlands and foothills (<400 m asl) of Central and East Kalimantan, Indonesia. The study area spans c.170 km east–west between the middle and upper reaches of the Barito and Mahakam Rivers, and more than 100 km north–south from the foothills of the Muller Range. Habitats surveyed include mixed dipterocarp forest, heath forest (*kerangas*), riparian forest and converted lands on a variety of substrates. A total of 226 species was recorded, including five Vulnerable species (Crestless Fireback *Lophura erythrophthalma*, Large Green Pigeon *Treron capellei*, Lesser Adjutant *Leptoptilos javanicus*, Hook-billed Bulbul *Setornis criniger* and Bornean Wren Babbler *Ptilocichla leucogrammica*) and 59 Near Threatened species. Habitat, land use and soil quality varied widely across the study area. The north-west section of the study area boasts large tracts of intact, continuous-canopy dipterocarp and heath forest and is likely to support viable populations of a variety of rare and threatened species. The influence of logging disturbance is briefly discussed, and the bird communities of dipterocarp and heath forests are broadly compared.

INTRODUCTION

Sundaland, comprised of the Malay Peninsula, Sumatra, Java, Bali and Borneo, is among the most biologically diverse and endemically rich regions on earth (Myers *et al.* 2000). In recent decades, Sundaic forests have been seriously depleted by multiple large-scale pressures, including legal and illegal logging, conversion to commercial agriculture, smallholder farming, forest fire and unsustainable mining (Siegert *et al.* 2001, Holmes 2002, Fuller *et al.* 2004, Sodhi *et al.* 2004, Gibbs *et al.* 2010). Most of the forest loss has occurred in the biodiversity-rich lowlands, with remaining habitat being converted at a rate that ranks among the highest in the world (Achard *et al.* 2002, FWI/GFW 2002, MacKinnon 2005, Hansen *et al.* 2008). As a result, much of the island's lowland biota is severely depleted and increasingly fragmented, and 109 (c.26%) of Borneo's resident bird species are listed by the International Union for the Conservation of Nature (IUCN) as threatened or 'Near

Threatened' with extinction (IUCN 2010) (hereafter 'IUCN priority species').

Until recently, Kalimantan's interior forests have been among the last to resist major conversion pressures (Holmes 2002, FWI/GFW 2002, Fuller *et al.* 2004), owing in part to their relative remoteness and the nutrient-poor soils that characterise much of the territory (MacKinnon *et al.* 1996). Indeed, despite the high rates of destruction observed over much of the island, these areas still support the largest tracts of lowland forest remaining in Sundaland, and are therefore capable of playing a critical role in maintaining biodiversity within the region. However, temporary isolation does not amount to immunity, and the majority of Kalimantan's interior low-elevation forests are presently under licence for timber harvesting, palm oil production, mineral exploration and other development projects (FWI/GFW 2002).

Despite the high conservation value of Borneo's forests, relatively little is known of the status and distribution of fauna across much of

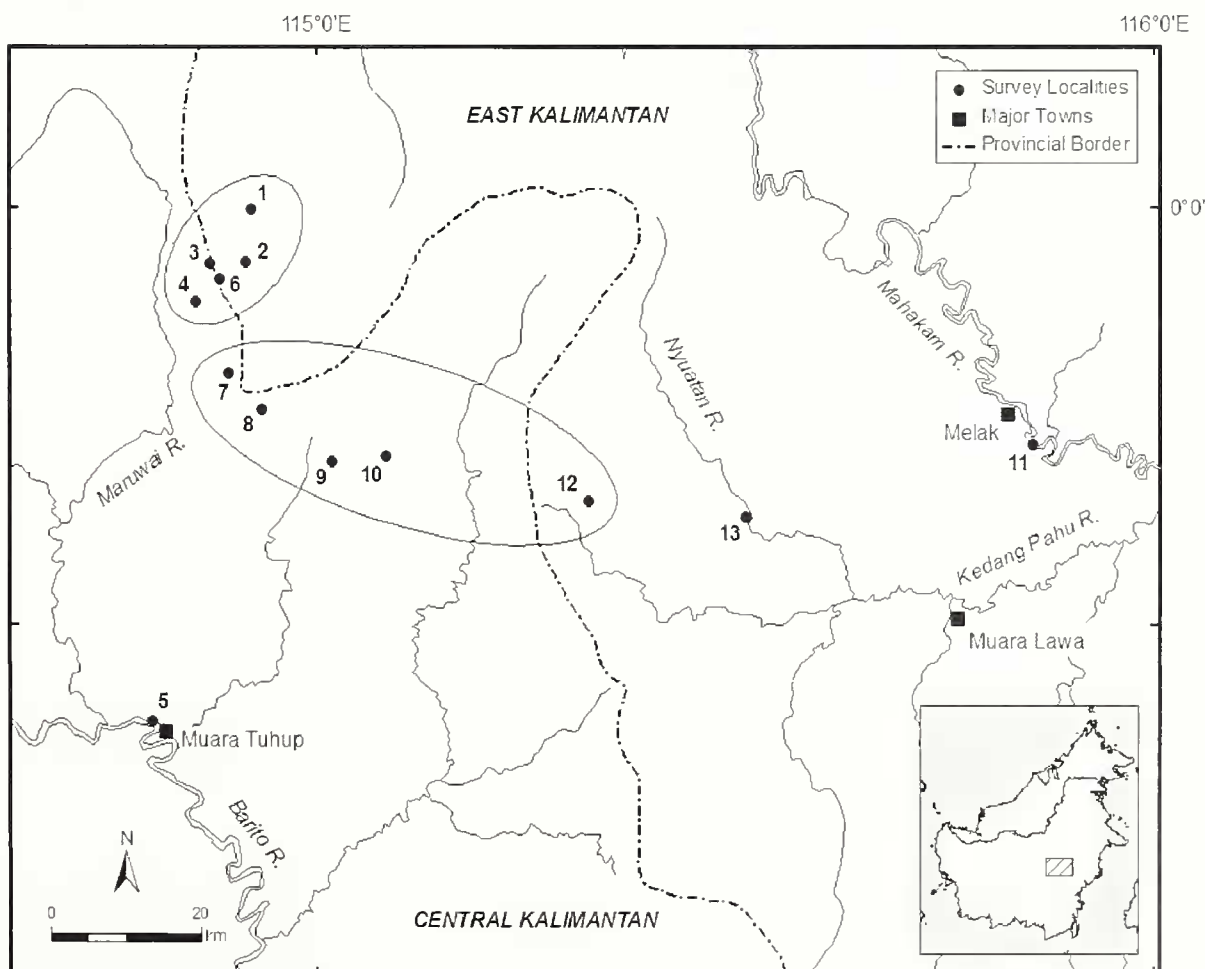


Figure 1. Map showing location of survey sites.

the island. To date, the majority of ornithological research has focused on the Malaysian states of Sarawak and Sabah and the near-coastal forests of Kalimantan (Mann 2008). Among the relatively few recent surveys conducted in Kalimantan's vast interior, most have focused on sub/montane habitats (e.g. Nurwatha 1996, van Balen 1997, Brickley *et al.* 2010) or wetlands (e.g. van Balen 1996, Gönner 2000, Budiono *et al.* 2006). Consequently, the distribution of avifauna throughout much of the interior lowlands is still poorly understood.

In this paper we present the results of three rapid-assessment ornithological surveys conducted in 2000 and 2006 between the Barito and Mahakam Rivers in the interior lowlands and hills of Central and East Kalimantan (Figure 1). Prior knowledge of the avifauna of this region comes largely from collections acquired during the nineteenth and early twentieth centuries (e.g. C. Schwaner 1843–

48, G. Fischer 1870s and Carl Lumholtz 1915–16; see summary and references in Mann 2008). Recent formal inventories have focused largely on the Middle Mahakam Wetlands to the east of our study area (e.g. Gönner 2000, Budiono *et al.* 2006), and the lowland and submontane forests of Barito Ulu, some 90 km to the west (Dutson *et al.* 1991, Wilkinson *et al.* 1991, McConkey and Chivers 2004).

We examine patterns of bird community composition in relation to geographic and habitat factors, and discuss records of a number of species that are of conservation concern. Although limited by temporal and logistic constraints common to rapid-assessment surveys, it is hoped that the results presented here will encourage further studies and help inform sustainable land use management practices and government land use planning agencies during the development and operation of various projects planned for the region.

Study area and habitat

The study area spans c. 105 km south to north from Muara Tuhup on the Barito River to the foothills of the Muller Mountains, and 170 km west to east from the village of Baloi to Empakuq and Melak on the Mahakam River (Figure 1). The area is subject to an equatorial climate that is warm and humid throughout the year. The mean annual rainfall of 2,750–3,500 mm is weakly seasonal, with most rain falling November–May (Wilkinson *et al.* 1991).

Surveys were conducted from 13 sites in three phases. Phase I surveys (2000) were conducted by RAN in the north-west section of the study area. Phase II and III surveys (2006) were conducted by IAW in all sections of the study area. Table 1 lists the survey dates, base coordinates, elevation and survey effort for each site. All surveys were conducted below 400 m above sea level.

Four broad habitat classes were encountered in the study area: mixed dipterocarp forest (MDF), heath forest (*kerangas*), riparian forest and converted lands (urban areas, crops, gardens, scrub and early-stage secondary forest). Within each category we surveyed a variety of subhabitats that were defined by variations in topography, soils, drainage and degree of anthropogenic disturbance (Table 2). Differences in the extent and accessibility of various vegetation types meant that not all habitats were surveyed equally.

The study area was divided into three regions, within each of which the variety of habitats was broadly consistent across all sites.

North-west: Sites 1, 2, 3, 4 and 6

This area is situated less than 100 km south-east of the Ulu Barito Important Bird Area. The topography was characterised by undulating to occasionally steep hills (200–400 m) traversed by numerous streams and small rivers. The soils were dominated by infertile sands and yellow clays. Despite the gentle topography, much of the region was remote and difficult to access; all survey sites were more than 20 km from the nearest village, and the logging road that connects the area with Muara Tuhup to the south terminates prior to reaching the northernmost sites (1 and 2). Surveys were conducted from three established camps in the southern sector (Sites 3, 4 and 6) and from temporary forest camps at Sites 1 and 2.

Vegetation near Sites 3, 4 and 6 was mostly undisturbed tall (25–30 m) to moderate height (15–25 m) *kerangas* interspersed with moderately to heavily logged MDF. Transition between these forest types was often gradual, with MDF in valleys and slopes grading into *kerangas* on the upper slopes, ridges and plateaus. Forest stature decreased from the valleys to the ridges, such that tall *kerangas* on the middle to upper slopes included floristic elements of MDF (Paoli 2006). Also surveyed were riparian forest on limited-width (generally <20 m) flats alongside the Lampunut River, (Site 6) and mature, lightly logged MDF on more fertile loams south-east of Site 6. There were multiple forest clearings of <0.5 ha to >2 ha at these sites.

Sites 1 and 2 were situated in State Protection Forest (*Hutan Lindung*) on the western rim of the Mahakam River catchment

Table 1. Survey dates, base coordinates and survey effort summaries for each survey site.

Site	Dates	Base coordinates		Elevation (m)	Observation hours ¹	Mist-netting (Diurnal net-metre hrs)
		Latitude	Longitude			
Phase I 2000						
1	22–27 March	0°00.05S	114°55.23E	180	23.5	4,648
2	29 Mar–1 Apr	0°03.90S	114°55.09E	300	19.5	5,264
3	3–4 Apr	0°03.92S	114°52.30E	280	10.5	1,862
4	5–8 Apr	0°06.73S	114°51.31E	320	13.0	3,724
Phase II 2006						
5 (Muara Tuhup)	19–27 Feb	0°36.98S	114°48.17E	35	35.5	5,514
6	27 Feb–5 Mar	0°05.18S	114°53.04E	265	36.75	5,381
4	5–13, 18 Mar	0°06.73S	114°51.31E	320	39	6,328
2	12–17 Mar	0°03.90S	114°55.09E	300	28.25	2,349
7	18–26 Mar	0°11.75S	114°53.60E	65	14.75	2,905
8	18–26 Mar	0°14.50S	114°56.10E	65	14.25	-
9 (Baloi)	26–30 Mar	0°18.16S	115°01.14E	50	10.25	842
10	28–29 Mar	0°17.84S	115°04.99E	50	10.25	-
Phase III 2006						
11 (Empakuq)	20–24 May	0°16.89S	115°51.35E	35	22	1,208
12	25–28 May	0°21.03S	115°19.49E	95	15.5	1,551
13 (Dempar)	28–31 May	0°22.10S	115°30.63E	25	13.75	1,080

¹ 'Observation hours' includes formal, active search time only and excludes periods of opportunistic birding (e.g. sightings from camp, deploying and retrieving mist-nets, reconnaissance drives, etc.).

Table 2. Habitats encountered at each survey site.

Site	MDF	Riparian forest	Heath forest (<i>kerangas</i>)	Converted lands
North-west				
1	1 ^{b,c}	1 ^a		
2	1–2 ^b		6,7 ^b	
3			5 ^b	
4	3–4 ^b		5 ^b , 7 ^a	
6	2–4 ^e	1–3 ^b	6 ^{b,d}	
Central West				
7	2–3 ^b	1–4 ^b		
8	3 ^{b,f} , 4 ^f		6 ^c	
9 (Baloi)	4 ^f			9,11 ^f
10	2–4 ^b			
12	2 ^c , 3 ^{c,g} , 4 ^c			
Tuhup & East				
5 (Muara Tuhup)	2 ^b	2–3 ^b		9–11 ^b
11 (Empakuq)	4 ^g	1 ^b	8 ^d	9 ^a , 10 ^{a,g} , 11 ^{a,d}
13 (Dempar)	2 ^{a,c,g} , 3–4 ^{a,c}	3–4 ^{a,c}		9–11 ^{a,c}

MDF and riparian forest: 1 = primary, 2 = lightly logged/disturbed, 3 = moderately logged/disturbed, 4 = heavily logged; *Kerangas*: 5 = tall (25–30 m), 6 = moderate-height (15–25 m), 7 = short (12–15 m), 8 = stunted (<6 m); Converted lands: 9 = rubber/fruit *kebun* and post-*ladang* secondary forest, 10 = active *ladang* and other agricultural lands, 11 = *ladang* regrowth and post-burn scrub. Substrate/soils: ^a brown clay, ^b orange/yellow clay, ^c sandy orange/yellow clay, ^d white sands, ^e brown loam, ^f volcanics, ^g waterlogged, periodically inundated (sandy) clays, ^h permanent swamp.

(East Kalimantan). The steep, hilly topography supported largely undisturbed MDF on yellow clays, and an area of *kerangas* c.1 km west of the Site 2 camp.

Central West: Sites 7, 8, 9, 10 and 12

Surveys of the central western section were conducted from an established camp at Site 7, Baloi village (Site 9) and a temporary forest camp (Site 12) located near a logging camp c.5 km south-west of Intu Lingau village. Areas around Sites 8 and 10 were accessed from Sites 7 and 9.

Legal and illegal logging were active across this region, including in areas of Protection Forest around Sites 8, 9 and 10. Most of the habitat consisted of lightly to heavily logged MDF. Closed-canopy forest was less common than in the north-west, although extensive areas of lightly logged forest still occurred on the steep clays between Sites 7 and 8. Sites 10 and 12 were characterised by undulating hills traversed by streams and small rivers, with lightly to heavily logged MDF on sandy clays. At the time of the surveys, forest at Site 12 was subject to illegal manual logging following initial and legitimate mechanised logging. Areas east of Site 8 and around Site 9 were flat with fertile volcanic soils and had been heavily logged in preparation for oil palm *Elaeis guineensis*. Also surveyed were riparian forest on limited-width riverine flats at Site 7, and an isolated patch of *kerangas* on poorly drained, infertile soils west of Site 8. Cultivated land predominated at Baloi village (rubber/fruit *kebun* [gardens] and active *ladang* [agricultural fields]).

Tuhup and the East: Sites 5, 11 and 13

Surveys of this sector were conducted from three sites situated on major rivers: Muara Tuhup village (Site 5) on the Barito River, Empakuq village (Site 11) on the Mahakam River and Dempar village (Site 13) on the Nyuatan River, a major Mahakam tributary. These areas are well populated, and non-riparian habitats were characterised by a matrix of converted lands associated with shifting cultivation (active *ladang* and regrowth, rubber/fruit *kebun*, secondary forest) interspersed with remnant patches of MDF. MDF remnants were typically infrequent and small (<50 ha), and often located on ridges, steep slopes or on poorly drained soils presumably unsuitable for agriculture. These habitats were surveyed along the 5 km section of road leading north from Site 5, in lands west of the Nyuatan River accessed from three landing sites located 1–3 km downstream from Site 13, and in an area south-west of the Mahakam River that ran some 4 km south from Site 11. Birds were also surveyed in stunted (<6 m high), heavily fragmented *kerangas* protected within the Kersik Luway Nature Reserve (c.5,000 ha). Riparian habitats were surveyed along the Barito and Nyuatan Rivers and in undisturbed backwater swamp forest behind the eastern banks of the Mahakam River near Empakuq.

METHODS

Survey methods

Birds were formally surveyed using a combination of active searches and mist-netting. Active surveys were conducted along logging roads and vehicular tracks, along walking trails in closed forest and along the banks of rivers and creeks, and by boat along the Nyuatan and Mahakam Rivers and in undisturbed swamp forest near Empakuq. Care was taken to avoid double-counting of mobile species (e.g. aerial foragers, raptors) during active surveys, and cumulative counts were avoided where trails were walked more than once. Active surveys were preferentially conducted early to mid-morning (05h30–10h00, Central Kalimantan time) and from late afternoon to shortly after dusk (15h00–18h30) to cover active periods of both diurnal and nocturnal birds. Opportunistic observations were also recorded from camps and during reconnaissance drives.

Birds were identified visually and by call. Unfamiliar calls and periods of peak birdsong activity (e.g. dawn chorus, noisy feeding flocks) were routinely recorded by IAW in 2006 using a Sony HiMD minidisc recorder and Sennheiser ME64 cardioid microphone. Unfamiliar calls were matched against an extensive database of South-East Asian bird calls (Scharringa 2005; www.xeno-canto.org/asia/; www.hkbws.org.hk; personal records). At selected sites calls were played aloud using a Toa 15-watt megaphone in an effort to elucidate a response from cryptic species (e.g. night birds, pheasants, partridges and babblers).

Between 2 and 11 mist-nets (6–14 m, 31 mm mesh) were deployed at most sites for a total of more than 42,000 diurnal net-metre hours (Table 1). Most nets were erected close to the ground (all <7 m high) and checked hourly by the authors or trained assistants. Nets were furled during periods of heavy rain and at night.

Direct observational data were supplemented with records provided by local villagers from Baloi, Intu Lingau, Dempar and Muara Tuhup. During interviews, villagers who displayed a particular knowledge of local avifauna were shown images of selected birds in MacKinnon & Phillipps (1999). A conservative approach was adopted when interpreting information from local informants; the opinions reported here are provided with relevant context and concern only those species that are likely to be snared by hunters and/or are kept as pets.

Birds were censused using point counts in 2006, the results of which are to appear elsewhere. Estimates of abundance are provided in the text for IUCN priority species.

Taxonomy, status and statistical methods

Sequence and nomenclature (common and scientific names) follow Inskipp *et al.* (1996). The global conservation status of all species was taken from IUCN (2010). The list of species protected under Indonesian law was obtained from Noerdjito & Maryanto (2001).

We used species accumulation curves and a cluster analysis to explore the data and help to illustrate inventory completeness and patterns of bird community composition across the landscape. Survey sites were clustered according to similarity in species composition by means of a hierarchical (agglomerative) cluster analysis using the SPSS version 12.0 statistical package. A dendrogram was generated from presence/absence data using the centroid method and Jaccard's similarity index.

RESULTS

A total of 226 species from 41 families was directly recorded (excluding information from local informants) (Appendix 1), including five species listed as threatened by IUCN (Crestless Fireback *Lophura erythrophthalma*, Large Green Pigeon *Treron capellei*, Lesser Adjutant *Leptoptilos javanicus*, Hook-billed Bulbul *Setornis criniger* and Bornean Wren Babbler *Ptilocichla leucogrammica*), 59 Near Threatened species, and 43 species that are protected under Indonesian law. Ninety-seven species are endemic to the Sunda subregion, two are restricted to the Greater Sunda islands and eight are Bornean endemics.

Species discovery curves for each of the nine sites surveyed in 2006 are shown in Figure 2. Species totals (excluding provisional records) were highest at Sites 4 (131) and 2 (113), and lowest at Sites 10 (51), 3 (76) and 12 (78). Variation in survey time influenced the completeness of inventories among sites. Shorter surveys at Sites 9, 10, 12 and 13 yielded lists that fall well short of a full census. However, despite more extensive surveys at other locations, by the end of each survey new bird species were still being recorded daily, and none of the curves in Figure 2 approaches a clear asymptote.

A total of 440 birds from 67 species were captured in mist-nets (Appendix 1). At most sites multiple species were captured that

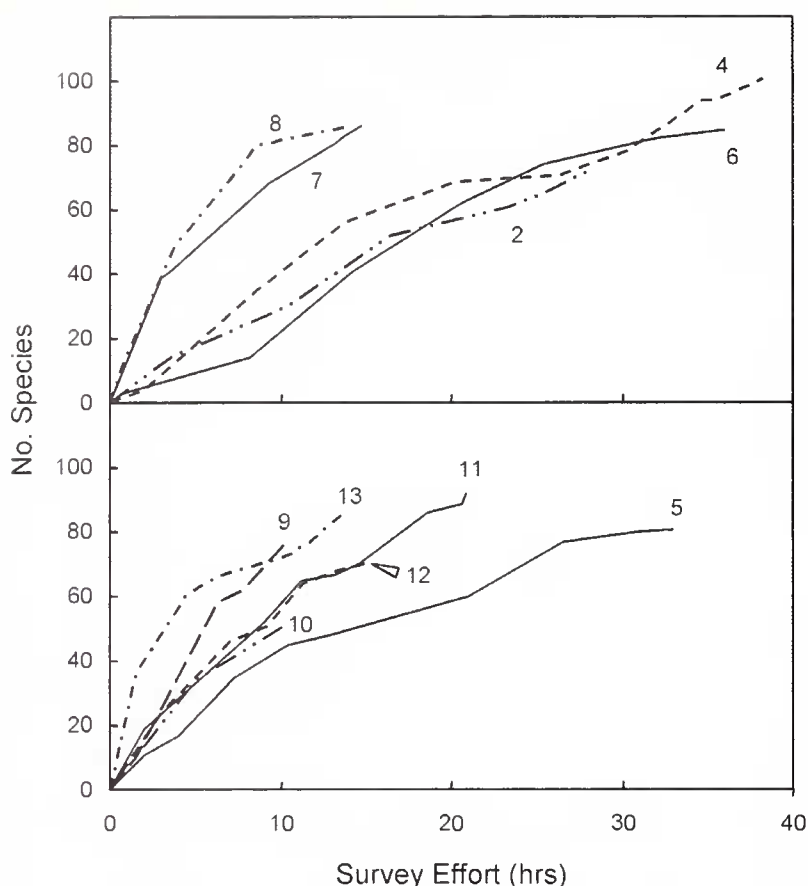


Figure 2. Species discovery curves (mist-net records excluded) for each of the 11 sites surveyed in 2006. Figures show site codes.

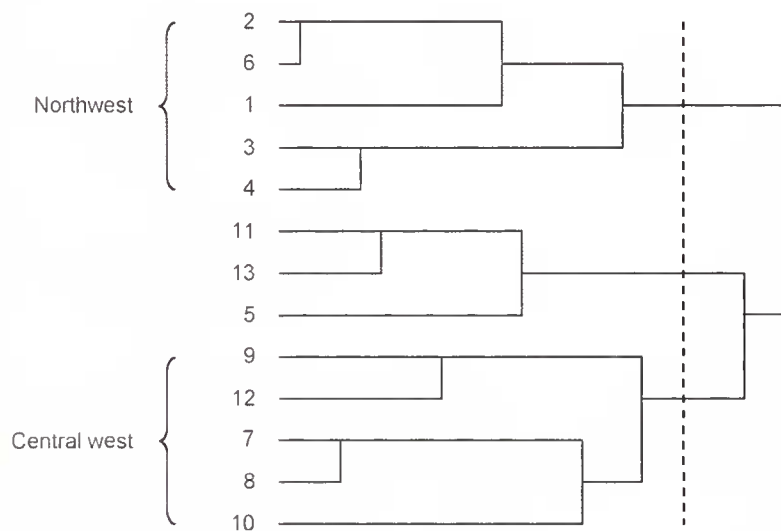


Figure 3. Dendrogram showing similarity between survey sites based on bird species composition. The dotted line indicates the point at which three broadly recognisable avifaunal sectors (as discussed in the text) were separated. Figures show site codes.

were not detected by sight or sound. Across the study area, five species were confirmed present by trapping only: Rufous-chested Flycatcher *Ficedula dumetoria*, Chestnut-naped Forktail *Enicurus ruficapillus*, Grey-breasted Babbler *Malacopteron albogulare*, Striped Wren Babbler *Kenopia striata* and Grey-headed Babbler *Stachyris poliocephala*.

Four species (Crested Fireback *Lophura ignita*, Bulwer's Pheasant *L. bulweri*, Bornean Peacock Pheasant *Polyplectron schleiermacheri* and Bornean Ground Cuckoo *Carpococcyx radiatus*) were not recorded directly but are provisionally included in Appendix 1 based on information provided by local residents or field assistants.

A comparison of species composition between study sites showed that locations clustered broadly according to geographic proximity (Figures 1 and 3). Thus the five sites within each of the north-west and central west regions of the study area formed separate

clusters. In the north-west, bird communities at Sites 2 and 6 were most similar, while those of Sites 3 and 4 were also similar, although themselves rather distinct from the former site-pair. In the central west the bird communities at Sites 7 and 8 were most similar. Together with Site 5, the two easternmost sites (11 and 13) formed a third cluster.

Selected species accounts

Species accounts are provided for globally threatened taxa and/or species rarely recorded in Kalimantan according to Mann (2008). Unless otherwise stated, numbers of individuals recorded in specific habitats (described in the text or shown as figures in brackets) are taken from 2006 survey data. Relative abundance does not accurately reflect a preference for various habitats as not all habitats were surveyed equally.

Crestless Fireback *Lophura erythrophthalma* (Vulnerable)

In 2006 individual males were captured in gully *kerangas* at 260 m near Site 6, and in a sloping gully in lightly disturbed MDF at 300 m at Site 2. Two small, dark, female *Lophura* observed briefly near Site 4 in 2006 were also considered most likely this species. From c. 50 m the birds were flushed from beneath felled trees on the edge of a c. 1 ha regenerating clearing and flew some 15 m away from the observer into tall *kerangas* on a steep slope. *Lophura* are commonly snared by local hunters and the genus was recognised during all interviews. There is much potential for confusion, however, and some interviewees regarded male Crested *L. ignita* and Crestless Firebacks as separate sexes of the same species, suggesting both may occur in at least some areas. An experienced hunter interviewed at Dempar (Site 13) claimed to have eaten this or a Crested Fireback earlier the same day. Considered scarce in Borneo (BirdLife International 2001, Madge & McGowan 2002, Mann 2008); recorded at Barito Ulu (Wilkinson *et al.* 1991).

[Bulwer's Pheasant *Lophura bulweri* (Vulnerable)]

A scarce resident of (mostly) hill and montane forests, this species was the most commonly recorded *Lophura* at Barito Ulu in 1989, where it was encountered between 150 and 250 m (Wilkinson *et al.* 1991). In 2006 a field assistant (Pandam Nugroho) saw a white-tailed pheasant from close range at c. 275 m at Site 2. In addition, the hunter at Dempar claimed to know Bulwer's Pheasant from forest around Intu Lingau, but said it was no longer present in areas that had been logged.]

[Bornean Peacock Pheasant *Polyplectron schleiermacheri* (Endangered)]

A rare Bornean endemic with most recent records coming from Kalimantan (Madge & McGowan 2002, Mann 2008). The hunter at Dempar recognised this species and, unprompted, correctly pointed out the twin leg spurs unique among the island's pheasants. He reported that it was formerly present in hunting grounds around Intu Lingau but he had not seen it after the area was logged. Not recorded at Barito Ulu (Wilkinson *et al.* 1991).]

Grey Nightjar *Caprimulgus indicus*

The distinctive song of this species was heard for extended periods (c. 20 minutes) shortly after dusk, and occasionally during the night, over two consecutive nights (13 and 14 March 2006) from an area of disturbed forest adjacent to a small river at Site 2. Previously recorded in small numbers as a winter visitor to Malaysian Borneo and Brunei (*C. i. jotaka*) (Mann 2008), Brickle *et al.* (2010) note that their recent record from the Menyapa Mountains in East Kalimantan is the only other traceable record from Indonesian Borneo. Migratory races are typically less vocal on their wintering grounds, where they 'occasionally sing briefly' (Cleere 1998: 230). The presence of breeding birds cannot be ruled out.

Large Green Pigeon *Treron capellei* (Vulnerable)

A sparsely distributed inhabitant mostly of primary lowland Sundaic forests (BirdLife International 2001, Mann 2008). In 2006 a group of 10 birds was seen leaving a remnant patch of mature MDF in agricultural land near Site 5. Smaller numbers were recorded in logged MDF on volcanic soils near Sites 8 (3) and 9 (1). Its dependence on large figs suggests that this species is likely to be less common in *kerangas* and other low productivity forests, and it was not recorded in the relatively intact low-nutrient forests in the north-west of the study area.

Whiskered Tern *Chlidonias hybridus*

Occurs as a winter visitor and passage migrant throughout the year, with birds in breeding plumage suggesting the species may breed in Borneo, although this is yet to be confirmed (Mann 2008). On 22 May 2006, six birds in breeding dress were observed along the Mahakam River on the southern outskirts of Melak, a short distance upstream from Empakuq (Site 13). Birds were observed moving overland between the river and an unknown location to the west.

Blyth's/Wallace's Hawk Eagle *Spizaetus alboniger/nanus* (Vulnerable)

In 2006 a juvenile, long-crested hawk eagle was observed perched in a tree along the main road at Site 12. Blyth's and Wallace's Hawk Eagles, particularly juveniles, can be difficult to separate in the field (BirdLife International 2001, Ferguson-Lees & Christie 2005). Although the low elevation (95 m) is often considered more suitable for the Vulnerable Wallace's Hawk Eagle (Ferguson-Lees & Christie 2005), Blyth's Hawk Eagle has been reported from comparable altitudes in some localities (e.g. 130 m, Barito Ulu, Wilkinson *et al.* 1991).

Lesser Adjutant *Leptoptilos javanicus* (Vulnerable)

In Kalimantan this species occurs mostly along the Mahakam River (especially the Mahakam Lakes: Gönner 2000) and in scattered localities near the south coast including near Banjarmasin and along the Negara River (BirdLife International 2001, Budiono *et al.* 2006). In 2006 two Lesser Adjutants were recorded over heavily logged forest c.3 km north-east of Site 9. The birds were observed from a distance of c.1 km and rose on a thermal for over a minute before heading south. The habitat there included numerous small marshes created when the construction of a logging track interrupted drainage by a series of streams. Lesser Adjutants wander extensively (Mann 2008), and individuals may visit these areas as they travel between strongholds elsewhere. Discussions with local villagers suggest that the species does not occur frequently in the local area; it was not recognised by hunters from nearby Baloi, and a villager at Intu Lingau knew of this species only from the Mahakam Lakes.

Narcissus Flycatcher *Ficedula narcissina*

An uncommon winter visitor and passage migrant, mostly to northern Borneo. In 2006 a male was seen singing on the edge of tall *kerangas* near Site 4. This is the second record for Central Kalimantan (Mann 2008).

White-vented Myna *Acridotheres cinereus*

White-vented (Javan) Mynas, believed to be of captive origin, were first recorded in Borneo around Banjarmasin and Kuching in the 1970s and 1980s, and have since become established there. In 2006 two White-vented Mynas were observed in wet grazing land adjacent to the Mahakam River between Melak and Empakuq village. The birds rested on cattle, foraged on the ground and flew to cover in nearby fruit trees and secondary growth. This is the first record of this species from interior Borneo and the first confirmed record for East Kalimantan, although Smythies (1999) suggested that a record

of Crested Myna *Acridotheres cristatellus* from Rasamala on the lower Mahakam may in fact refer to this species.

Hook-billed Bulbul *Setornis criniger* (Vulnerable)

Endemic to the islands of Borneo, Sumatra and Bangka in the Greater Sundas. While generally regarded a specialist resident of *kerangas* and peat-swamp forests (Dutson *et al.* 1991, BirdLife International 2001), it has also been recorded in submontane (Dutson *et al.* 1991) and degraded mixed dipterocarp habitats (IAW pers. obs.). In 2000 a single bird was observed in *kerangas* at Site 2. It was not recorded in 2006. At nearby Barito Ulu it was recorded at several localities across a range of altitudes (120–1,000 m), where it showed a marked preference for *kerangas* (Dutson *et al.* 1991, Wilkinson *et al.* 1991).

Oriental/Everett's White-eye *Zosterops palpebrosus/everetti*

In 2006 three *Zosterops* were observed foraging in the canopy of a fruiting tree in moderately logged MDF at Site 7 and two were seen in similar habitat at Site 10. All birds showed grey flanks aside a yellow ventral line, though views were insufficient to distinguish between Oriental and Everett's White-eye. There are no records of Oriental White-eye from Central Kalimantan and Everett's White-eye is known from that province only at Barito Ulu (Wilkinson *et al.* 1991, Mann 2008).

Bornean Wren Babbler *Ptilocichla leucogrammica* (Vulnerable)

A scarce Bornean endemic of lowland primary evergreen forests and, less commonly, peat-swamp and logged forests (Lambert 1992, BirdLife International 2001). In 2006 at least three individuals were heard in lightly logged MDF at Site 2, and a single bird was heard in a large, mixed-species feeding flock in a 'belt' of MDF surrounded predominantly by *kerangas* at Site 6. Not recorded in 2000.

[Eyebrowed Wren Babbler *Napothera epilepidota*

In Borneo a scarce resident of hill and montane forest (Mann 2008). In 2006 a song attributed to this species was heard from close range at c.275 m in lightly logged gully MDF at Site 4. The bird was calling from sparse undergrowth alongside a rocky stream in steep, terraced, gully forest. The bird was not observed. However, the repeated thin, clear, falling whistles immediately recalled and proved indistinguishable from the characteristic song of this species (a pre-recording being immediately on hand for comparison). There was no response to call playback the following morning. In Central Kalimantan this species has been recorded previously only at Barito Ulu (800–900 m, Wilkinson *et al.* 1991). Although it occurs at comparable altitudes in mainland South-East Asia, if confirmed, this is the lowest reported Sundaic elevation for this species.]

DISCUSSION

These surveys reveal that the study area currently supports a rich bird assemblage which varies in community composition across the landscape. Of the 226 species recorded, nearly half (43.8%) are of global and/or national conservation significance, and more than one quarter (28.3%) are IUCN priority species. The high proportion of IUCN priority species recorded here is consistent with the results of bird surveys conducted elsewhere in lowland Borneo (e.g. Eames 2005), and reflects the extreme pressure placed on Indonesia's biota by the wholesale destruction of lowland forest and the high degree of international concern it has evoked (BirdLife International 2001, Holmes 2002, Sodhi *et al.* 2004).

Temporal and logistic constraints limited survey completeness at individual sites, and many more species will no doubt be recorded from the study area given additional survey time. Nevertheless, the combined list for all sites includes nearly three-quarters of

Kalimantan's resident lowland forest bird species (c.210/295, excluding waterbirds and migrants), and provides a useful base upon which to discuss how changes in habitat and land use influence avian community structure, and conservation value, at the landscape level.

A cluster analysis grouped bird communities into three broadly distinguishable avifaunal 'regions'. Sites within regions shared similar habitat features (see Methods) and in most cases sites clustered according to geographic proximity.

Tuhup and the east

As is the pattern in many developing regions (e.g. Tatem & Hay 2004), settlement in Borneo is most intensive in coastal areas and along its major roads and rivers. Sites 5, 11 and 13 were situated on the largest and only truly navigable watercourses visited during these surveys, and accordingly were the most densely populated. The distinctiveness of their avifauna was largely due to the dominant presence of converted lands and extensive riparian habitats along the Barito, Mahakam and Nyuatan Rivers.

Of 23 species recorded only at these sites, nine (39.1%) are residents of agricultural lands, urban areas and heavily disturbed forests (Blue-throated Bee-eater *Merops viridis*, Rock Pigeon *Columbalivia*, nightjar sp. (probably Savanna/Large-tailed), Black-thighed Falconet *Microhierax fringillarius*, White-breasted Woodswallow *Artamus leucorhynchus*, Common Iora *Aegithina tiphia*, White-vented Myna, Scarlet-backed Flowerpecker *Dicaeum cruentatum*, Olive-backed Sunbird *Nectarinia jugularis*), four (17.4%) are found almost exclusively in wetlands (Stork-billed Kingfisher *Halcyon capensis*, Whiskered Tern, White-breasted Waterhen *Amaurornis phoenicurus*, Grey-headed Fish Eagle *Ichthyophaga ichthyætes*), and four are predominantly riparian and secondary forest species that were recorded only in the Mahakam swamps (Cinnamon-headed Green Pigeon *Treron fulvicollis*, Oriental Pied Hornbill *Anthracoceros albirostris*, Black-and-red Broadbill *Cymbirhynchus macrorhynchos*, Malaysian Blue Flycatcher *Cyornis turcosus*).

The value of riparian forest to wildlife and humans alike, particularly in converted landscapes, has been a topic of some focus (e.g. Darveau *et al.* 1995, de Lima & Gascon 1999, Lees & Peres 2008). In the present study, 20 Near Threatened bird species were recorded in riparian forest at these sites. The majority of these were recorded more widely across the study area and in a variety of forest habitats. Riparian forest is of more direct importance to species such as Cinnamon-headed Green Pigeon, Malaysian Blue Flycatcher (at least on Borneo) and especially Grey-headed Fish Eagle.

Thirteen Near Threatened species were recorded in converted habitats at these sites (Buff-necked Woodpecker *Meiglyptes tukki*, Red-crowned Barbet *Megalaima rafflesii*, Red-throated Barbet *M. mystacophanos*, Lesser Green Leafbird *Chloropsis cyanopogon*, Green Iora *Aegithina viridissima*, Black-and-white Bulbul *Pycnonotus melanoleucos*, Puff-backed Bulbul *P. eutilotus*, Buff-vented Bulbul *Iole olivacea*, Short-tailed Babbler *Malacocinclla malaccensis*, Rufous-crowned Babbler *Malacopteron magnum*, Fluffy-backed Tit-Babbler *Macronous ptilosus*, Brown Fulvetta *Alcippe brunneicauda*, Scarlet-breasted Flowerpecker *Prionochilus thoracicus*). All are Sundaic endemics and most occur predominantly or solely below c.800 m. Most of these species were recorded in secondary forest (*vis-à-vis* active *ladang*, gardens, regrowth scrub, urban areas). The role of secondary forests in preserving biodiversity is emerging as a key issue in tropical conservation biology (Wright & Muller-Landau 2006, Chazdon *et al.* 2009). While there are extensive records of the occurrence of Bornean birds in converted habitats (summarised in Mann 2008), most are based on informal observations (cf. e.g. Koh 2008, Edwards *et al.* 2010), and there is a growing need for detailed studies into the value of such habitats. In particular, future studies should examine the potential for secondary habitats to support forest-dwelling Sundaic birds in relation to a variety of geographic and

ecological parameters, including the size, shape and degree of isolation (from primary forest) of individual habitat patches, stage of regeneration, and floristic, structural and edaphic characteristics.

In a national context, converted lands supported a variety of passerines protected under Indonesian law, including the Pied Fantail *Rhipidura javanica*, numerous sunbirds and the Little Spiderhunter *Arachnothera longirostra*. This situation reflects the current legislative focus on culturally significant species rather than on those forest-dependent birds that have suffered most from the destruction of Sundaic forests.

Anthropogenic landscapes also included small areas (often <5 ha) of remnant primary and/or moderately disturbed MDF within the dominant agricultural matrix. In these fragments a number of Near Threatened passerines were recorded, including Black-and-yellow Broadbill *Eurylaimus ochromalus*, Lesser Green Leafbird, Green Iora, Rufous-tailed Shama *Trichixos pyrropyga*, and a variety of bulbuls and babblers. They also provided a source of fruiting trees for mobile frugivores such as hornbills and barbets. While forest fragments do not match continuous forest in avian diversity and abundance (Edwards *et al.* 2010), depending on their size, condition and proximity to remnant habitats, and, especially in relation to larger species such as hornbills, on the prevalence of hunting, these remnant forest patches may be important for the persistence of local or regional populations of some (but not all) species from a variety of guilds (Kinnaird & O'Brien 2007, Edwards *et al.* 2010).

The north-west and central west forests

Larger areas of forest were surveyed in the north-west and central west sections of the study area. The structure, condition and soil profile of these forests were highly variable. Noticeable differences in habitat between these regions included: (1) extensive, predominantly intact *kerangas* present in the north-west; (2) the presence of rich, volcanic soils near Sites 8 and 9; and (3) continuing intensive logging near Sites 9, 10 and 12.

The north-west section is situated within an increasingly rare example of a large expanse of relatively intact Indonesian lowland and hill forest which stretches far west and north across the Murung Raya district. This area is likely to support viable populations of at least three Vulnerable species recorded during the surveys: Crestless Fireback, Hook-billed Bulbul and Bornean Wren Babbler. Further surveys may reveal/confirm the presence of additional threatened taxa such as Black Partridge *Melanoperdix nigra*, Bulwer's Pheasant, Bornean Peacock Pheasant, Bonaparte's Nightjar *Caprimulgus concretus*, Large Green Pigeon and Blue-headed Pitta *Pitta baudii*. Of these species all but the Bornean Peacock Pheasant and Bonaparte's Nightjar are known from Barito Ulu (Wilkinson *et al.* 1991).

The structural integrity of *kerangas* was high in comparison to most MDF surveyed. These low-productivity forests are of limited interest to loggers or farmers, and comparatively few logging roads were traversed while surveying this habitat. *Kerangas* supports a handful of (near-)specialist species such as the Grey-breasted Babbler and Hook-billed Bulbul, both of which were found only in the north-west, but have also been found further west in Barito Ulu (Wilkinson *et al.* 1991). In 2006 a further 22 species were recorded only in the north-west, most of which may also be expected to occur within the study area in forests to the south.

Much of the forest surveyed in the central west was already heavily disturbed. Forest on the rich volcanic plains around Sites 8 and 9 had been very heavily logged and few emergent trees remained. Nevertheless, these sites did support a relatively rich bird community, with 117 species recorded (including 34 IUCN priority species) over a relatively short survey period (Fig. 2). If left alone, forest on these soils can be expected to make a rapid recovery relative to logged forest in less fertile areas. Unfortunately it is these fertile

lowland forests on gentle terrain that are targeted most heavily by developers seeking to plant crops such as oil palm.

Following intensive logging, forest on less fertile soils at Site 12 was of a similar structure to that observed at Sites 8 and 9. Many forest birds common at other locations in the central west were scarce at Site 12, and a number of vocal species were not recorded during the brief survey (e.g. Red-throated Barbet, Yellow-crowned Barbet *Megalaima henricii*, Greater Green Leafbird *Chloropsis sonnerati*, Blue-winged Leafbird *C. cochinchinensis*, Grey-headed Canary Flycatcher *Culicicapa ceylonensis*, Yellow-bellied Bulbul *Alophoixus phaeocephalus*, Moustached Babbler *Malacopteron magnirostre* and Sooty-capped Babbler *M. affine*). Although barbets vocalise less at certain periods (Wells 1999), both the Red-throated and Yellow-crowned Barbets were heard at Site 13 immediately after the Site 12 survey, suggesting their silence at Site 12 was not merely seasonal. Species richness was clearly lower at Site 12 than on the more fertile soils at Sites 8 and 9 (Fig. 2), but this was not formally quantified. Logged forests play a critical role in preserving biodiversity within Sundaic landscapes (Berry *et al.* 2010, Edwards *et al.* 2011). The influence of soil quality on the conservation value of degraded Sundaic forest habitats may be a worthwhile direction of inquiry.

Studies of rainforest bird communities have often shown that terrestrial and understorey insectivores are sensitive to logging and habitat fragmentation (Johns 1996, Lambert 1992, Thiollay 1997, Lambert & Collar 2002, Peh *et al.* 2005, Edwards *et al.* 2009). In addition to habitat loss and degradation, hunting pressure is likely to be high in the vicinity of logging camps (e.g. Bennett *et al.* 2000), such as those active at the time of survey near Sites 8, 9 and 12, with pheasants and partridges actively targeted by snaring. During our surveys a number of terrestrial taxa such as pheasants and wren babblers were scarce or absent from the logged forests of the central west. A notable exception was a Crested Partridge *Rollulus rouloul* heard calling in moderately logged forest at Site 10. By contrast, the Crestless Fireback, Great Argus *Argusianus argus*, Bornean Wren Babbler, Striped Wren Babbler *Kenopia striata* and Eyebrowed Wren Babbler were only recorded in the less disturbed forests of the north-west.

Woodpecker diversity and abundance were also lower in the heavily logged forests around Sites 8, 9 and 10 where few large trees remained. Lambert (1992) reported a similar pattern among woodpeckers in logged compared with primary forests of lowland Sabah, while Lammertink (2004) reported no change in species richness over increasing levels of forest disturbance in West Kalimantan. As with many other taxa, the relationship between woodpeckers and logging disturbance is complex, with various studies indicating a variety of responses both within and between species (Meijaard *et al.* 2005).

Community structure in dipterocarp forest and *kerangas*

Soil quality in the north-west was generally poor; *kerangas* was common and unlogged MDF was of a smaller stature than at Sites 7 and 10 and many other regions of lowland Kalimantan (Paoli 2006). The low-nutrient, acidic soils of this region supported relatively few fruiting trees. Accordingly, a number of frugivorous guilds were poorly represented in *kerangas*, with many species of hornbill, pigeons and doves, bulbuls, partridges and pheasants (insectivore/frugivores) apparently scarce or absent. Low hornbill abundance has also been reported in the nutrient-poor forests of Barito Ulu (McConkey & Chivers 2004). A notable exception was the Crestless Fireback: three of the four individuals encountered in 2006 were encountered in *kerangas*.

Compared to MDF, a number of insectivores were also poorly represented in *kerangas*. Many terrestrial insectivores recorded in MDF were not recorded in *kerangas* (e.g. wren babblers, White-chested Babbler *Trichastoma rostratum*), and muscicapid flycatchers,

cuckoos and cuckooshrikes were relatively scarce and species-poor. In addition, some woodpeckers that were common in MDF were either not recorded in *kerangas* (Crimson-winged Woodpecker *Picus puniceus*, Great Slaty Woodpecker *Mulleripicus pulverulentus*) or were present in relatively low numbers (Buff-rumped Woodpecker *Meiglyptes tristis*). The diversity and abundance of invertebrates is reportedly lower in *kerangas*, a pattern attributed to the relatively low floristic and structural diversity present in this habitat (MacKinnon *et al.* 1996, Robinson & Tuck 1996). As well as a reduced availability of larval and non-flying insects, the relative scarcity of large trees may have rendered heath forests within the study area less suitable for many woodpecker species.

Final remarks

These surveys help to provide a basic understanding of avian community composition and the habitat preferences of various taxa within the study area. However, our data are insufficient to allow a detailed assessment of the distribution and status of many rare and threatened species that have been recorded or are likely to occur. Nevertheless, it appears likely that the western portion of our study area does support viable populations of at least four globally threatened bird species (Crestless Fireback, Large Green Pigeon, Hook-billed Bulbul, Bornean Wren Babbler), and that further surveys may confirm the presence of additional priority taxa. The occurrence of these species meets the criteria set by BirdLife International (2009) for this region to be nominated a global Important Bird Area (IBA).

Processes threatening forest in the present study area include unsustainable logging, agro-industrial plantations (oil palm) and, in the north-west and immediate surrounds, small-scale mining, in particular those mining leases issued by local government. A number of mineral and resource companies have been actively commissioning biological surveys in the vicinity of our study area.

In a broader context, with much of Kalimantan's interior still unsurveyed, further work will be essential to provide the basic information that is normally required to prioritise areas for conservation. Unfortunately, much of Kalimantan's forests are converted without prior knowledge of the wildlife they contain. This increases both the urgency of additional surveys in, and the inherent conservation value of, remaining tracts of relatively intact and continuous canopy forest.

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Appendix 1

Birds recorded in Central and East Kalimantan in 2000 and 2006

CS = conservation status; SS = seasonal status

Species ^{1,2}	CS ³	SS ⁴	Site ⁵	Habitat ⁶
Crested Partridge <i>Rallulus raulaul</i>	NT	R	1,10	MDF
Crestless Fireback <i>Laphura erythrphthalma</i> (2)	VU	R	2,[4],6	MDF,ker
[Crested Fireback <i>Laphura ignita</i>]	NT	R	12(L),13(L)	
[Bulwer's Pheasant <i>Laphura bulweri</i>]	VU, P	R	[2],12(L*)	MDF
[Bornean Peacock Pheasant <i>Palyplectran schleiermacheri</i>]	EN	R	12(L*)	
Great Argus <i>Argusianus argus</i>	NT, P	R	2,4	MDF
Malaysian Honeyguide <i>Indicatar archipelagicus</i> (1)	NT	R	5	Rip
Rufous Piculet <i>Sasia abnormis</i> (3)		R	1,2,4,7–9	MDF
Grey-capped Pygmy Woodpecker <i>Dendrocopos canicapillus</i>		R	4,6	ker
Rufous Woodpecker <i>Ceelus brachyurus</i>		R	1,2	
White-bellied Woodpecker <i>Dryacopus javensis</i>		R	3,4,11–13	MDF,ker
Banded Woodpecker <i>Picus miniaceus</i>		R	[5],11	MDF, cl
Crimson-winged Woodpecker <i>Picus puniceus</i>		R	2–4,6,11–13	MDF
Checker-throated Woodpecker <i>Picus mentalis</i> (1)		R	1–4,6	MDF,ker
Maroon Woodpecker <i>Blythipicus rubiginasus</i> (1)		R	2,4,6	MDF,ker,Rip
Orange-backed Woodpecker <i>Reinwardtipicus validus</i>		R	1–3,11	MDF,Rip
Buff-rumped Woodpecker <i>Meiglyptes tristis</i>		R	1–4,6,8,12,13	MDF,ker
Buff-necked Woodpecker <i>Meiglyptes tukki</i> (4)	NT	R	1,4,11,12	MDF,Rip,cl
Grey-and-buff Woodpecker <i>Hemicircus cancretus</i>		R	1–4,6,7,9,11	MDF,ker
Great Slaty Woodpecker <i>Mulleripicus pulverulentus</i>		R	1–5,7–10,12	MDF
Gold-whiskered Barbet <i>Megalaima chrysapagan</i>		R	4,6–9	MDF,ker,Rip
Red-crowned Barbet <i>Megalaima rafflesii</i>	NT	R	1–6,8,10–13	MDF,ker,Rip,cl
Red-throated Barbet <i>Megalaima mystacaphanas</i>	NT	R	5–11,13	MDF,ker,Rip,cl
Yellow-crowned Barbet <i>Megalaima henricii</i>	NT	R	1,2,4–10,13	MDF,ker
Blue-eared Barbet <i>Megalaima australis</i>		R	1–13	MDF,ker,Rip,cl
Brown Barbet <i>Calarhamphus fuliginasus</i> (1)		R	1–5,7,8,10,12,13	MDF,ker,cl
Oriental Pied Harnbill <i>Anthraccercas albastris</i>		R	11	Rip
Black Hornbill <i>Anthraccercas malayanus</i>	NT, P	R	1–4,6,9,10,12	MDF,Rip
Rhinoceros Hornbill <i>Buceras rhinoceros</i>	NT, P	R	1–9,11–13	MDF,Rip
Helmeted Hornbill <i>Buceras vigil</i>	NT, P	R	1,4,8–10,13	MDF
Bushy-crested Hornbill <i>Anarrhinus galeritus</i>	P	R	2,4,6,11,12	MDF,Rip
White-crowned Hornbill <i>Aceras camatus</i>	NT	R	5,7,12	MDF

Species ^{1,2}	CS ³	SS ⁴	Site ⁵	Habitat ⁶
Wrinkled Hornbill <i>Aceros corrugatus</i>	NT, P	R	8,11	MDF
Wreathed Hornbill <i>Aceros undulatus</i>	P	R	1,3	
Wrinkled/Wreathed Hornbill <i>Aceros corrugatus undulatus</i>	[NT] P	R	9,13	MDF
Red-naped Trogon <i>Horpoctes kosumbo</i>	NT, P	R	1,2,[9]	MDF
Diard's Trogon <i>Horpoctes diordii</i>	NT, P	R	2,7,8,11,12	MDF
Scarlet-rumped Trogon <i>Horpoctes doucoucelii</i> (2)	NT, P	R	2-4,6-9,12,13	MDF,ker
Dollarbird <i>Eurystomus orientalis</i>		R,W	5	cl
Blue-eared Kingfisher <i>Alcedo meninting</i> (11)	P	R	1-3,5-7,11,13	MDF,Rip,cl
Oriental Dwarf Kingfisher <i>Ceyx erithocus</i> (17)	P	R,?W	2-7,9,12,13	MDF,Rip
Banded Kingfisher <i>Loceda pulchello</i>	P	R	6,8,12	MDF
Stork-billed Kingfisher <i>Holcyon copensis</i>	P	R	11,13	Rip
Red-bearded Bee-eater <i>Nyctornis omictus</i>		R	4,7,9	MDF,Rip
Blue-throated Bee-eater <i>Merops viridis</i>		R	5,11,13	MDF,cl
Moustached Hawk Cuckoo <i>Hierococcyx vogons</i>	NT	R	8,13	MDF
Hodgson's Hawk Cuckoo <i>Hierococcyx fugax</i>		R,W	1,7	MDF
Indian Cuckoo <i>Cuculus micropterus</i>		R,W	1,4,7-9,11-13	MDF,cl
Banded Bay Cuckoo <i>Cocomontis sonnerotii</i>		R	5,6,9,11-13	MDF,Rip,cl
Plaintive Cuckoo <i>Cocomontis merulinus</i>		R	1,5,7-13	MDF,Rip,cl
Rusty-breasted Cuckoo <i>Cocomontis sepulcrolis</i>		R	4,6,7	MDF
Violet Cuckoo <i>Chrysococcyx xonthorhynchus</i>		R	2,4,6-8,10-13	MDF,ker,cl
Drongo Cuckoo <i>Surniculus lugubris</i>		R	2,4,6-9,11,13	MDF,ker,Rip,cl
Black-bellied Malkoha <i>Phoenicophoeus diordi</i>	NT	R	2,6,7	MDF,ker
Chestnut-bellied Malkoha <i>Phoenicophoeus sumatranus</i>	NT	R	3,4,6,11	MDF,ker,Rip
Raffles's Malkoha <i>Phoenicophoeus chlorophoeus</i>		R	1,4,7,10,13	MDF,cl
Red-billed Malkoha <i>Phoenicophoeus javonicus</i>		R	4	
Chestnut-breasted Malkoha <i>Phoenicophoeus curvirostris</i>		R	2-4,7,11	MDF
[Bornean Ground Cuckoo <i>Corpococcyx radiotus</i>]	NT	R	13(L)	
Greater Coucal <i>Centropus sinensis</i>		R	4,5,8-13	MDF,Rip,cl
Lesser Coucal <i>Centropus bengolensis</i>		R	1,9,11	cl
Blue-rumped Parrot <i>Psittinus cyonurus</i>	NT	R	2-4,8,10,13	MDF,ker
Blue-crowned Hanging Parrot <i>Loriculus golgulus</i>		R	2-8,10-13	MDF,ker,cl
Glossy Swiftlet <i>Collocalio esculento</i>		R	1-4,6	cl
Edible-/ Black-nest Swiftlet <i>Collocalio fuciphogo/moximo</i>		R	1,2,4-7,13	MDF,Rip,cl
Silver-rumped Needletail <i>Rhophiduro leucopygiolis</i>		R	1-4,6-10,12,13	MDF,ker,cl
Brown-backed Needletail <i>Hirundopus giganteus</i>		R	3-5,13	Rip,cl
Grey-rumped Treeswift <i>Hemiprocne longipennis</i>		R	2-13	MDF,ker,Rip,cl
Whiskered Treeswift <i>Hemiprocne comoto</i>		R	1-7,12	MDF,ker,cl
Collared Scops Owl <i>Otus bakkomoeno</i>		R	1,2,[5]	cl
[Barred Eagle Owl <i>Bubo sumatranus</i>]		R	[2]	MDF
Brown Wood Owl <i>Strix leptogrammico</i>		R	2	MDF
Brown Hawk Owl <i>Ninox scutulato</i>		R,W	4,9	MDF,ker
Large Frogmouth <i>Botrochostomus ouritus</i>	NT	R	4	MDF
Gould's Frogmouth <i>Botrochostomus stellotus</i>	NT	R	2	MDF
Malaysian Eared Nightjar <i>Eurostopodus temminckii</i>		R	2,4-7,9,11,12	MDF,cl
Grey Nightjar <i>Coprimulgus indicus</i>		W	2	MDF
Nightjar <i>Coprimulgus</i> sp.		R	11	cl
Rock Pigeon <i>Columbo livio</i>		R	11	cl

Species ^{1,2}	CS ³	SS ⁴	Site ⁵	Habitat ⁶
Spotted Dove <i>Streptopelia chinensis</i>		R,?W	5,9,11	cl
Emerald Dove <i>Chalcophaps indica</i>		R	3,8,9,13	MDF
Cinnamon-headed Green Pigeon <i>Treron fulvicollis</i>	NT	R	11	Rip
Little Green Pigeon <i>Treron alax</i>		R	4,13	MDF
Pink-necked Green Pigeon <i>Treron vernans</i>		R	9,11	ker,cl
Thick-billed Green Pigeon <i>Treron curvirastra</i>		R	4,7,8,11–13	MDF,Rip,cl
Large Green Pigeon <i>Treron capellei</i>	VU	R	5,8,9	MDF
Jambu Fruit Dove <i>Ptilinopus jambu</i>	NT	R	3,4	ker
Green Imperial Pigeon <i>Ducula aenea</i>		R	2,[4],5,11–13	MDF,cl
White-breasted Waterhen <i>Amaurornis phaenicurus</i>		R	11	cl
Common Sandpiper <i>Actitis hypoleucos</i>		W,P	5	Rip
Whiskered Tern <i>Chlidanius hybridus</i>	P	W,Ws,P,?Mb	11	Rip
Oriental Honey-buzzard <i>Pernis ptilorhynchus</i>	P	R,W	13	Rip
Bat Hawk <i>Macheiramphus alcinus</i>	P	R	4,7	MDF,ker
Brahminy Kite <i>Haliastur indus</i>	P	R	5,7,11,13	Rip,cl
Grey-headed Fish Eagle <i>Ichthyophaga ichthyaetus</i>	NT, P	R	13	Rip
Crested Serpent Eagle <i>Spilarnis cheela</i>	P	R	1,3,7–10,12,13	MDF,Rip,cl
Crested Goshawk <i>Accipiter trivirgatus</i>	P	R	4	ker
[Japanese Sparrowhawk <i>Accipiter gularis</i>]	P	W	[4]	MDF
Black Eagle <i>Ictinaetus malayensis</i>	P	R	4,6	ker
Rufous-bellied Eagle <i>Hieraaetus kienerii</i>	P	R,?W	1	
Changeable Hawk Eagle <i>Spizaetus cirrhatus</i>	P	R	9	MDF
Blyth's Hawk Eagle <i>Spizaetus albaniger</i>	P	R	4	
Blyth's/Wallace's Hawk Eagle <i>Spizaetus albaniger/nanus</i>	[VU] P	R	12	MDF
Black-thighed Falconet <i>Micrahierax fringillarius</i>	P	R	4,11,12	MDF,cl
Little Heron <i>Butorides striatus</i> (1)	P	R,W,?P	1,5	Rip
Lesser Adjutant <i>Leptoptilus javanicus</i>	VU, P	R	9	MDF
Dusky Broadbill <i>Carydan sumatranus</i>		R	2,6,9,12	MDF,ker
Black-and-red Broadbill <i>Cymbirhynchus macrorhynchus</i>		R	11	Rip
Banded Broadbill <i>Eurylaimus javanicus</i>		R	1,2,6,7,9	MDF
Black-and-yellow Broadbill <i>Eurylaimus achramalus</i>	NT	R	1,2,4–9,11–13	MDF,ker,Rip
Green Broadbill <i>Calyptomena viridis</i>	NT	R	2,4,7–10,12	MDF,ker
Asian Fairy Bluebird <i>Irena puella</i>		R	1–8,10,13	MDF
Greater Green Leafbird <i>Chloropsis sannerati</i>		R	1–4,6,8,9	MDF,ker,Rip
Lesser Green Leafbird <i>Chloropsis cyanapagan</i> (1)	NT	R	3–5,7–13	MDF,ker,Rip,cl
Blue-winged Leafbird <i>Chloropsis cachinchinensis</i>		R	1–10	MDF,ker
Tiger Shrike <i>Lanius tigrinus</i>		W,P	8	MDF
Crested Jay <i>Platylaphus galericulatus</i>	NT	R	[1],2,6,8	MDF,ker
Black Magpie <i>Platysurus leucapterus</i>	NT	R	2–4,6–9,12,13	MDF,ker,Rip
Slender-billed Crow <i>Corvus enca</i>		R	5,7–9,11,13	MDF,Rip,cl
White-breasted Woodswallow <i>Artamus leucorhynchus</i>		R	11	cl
Bornean Bristlehead <i>Pityriasis gymnacephala</i>	NT	R	2–4,8	MDF,ker
Dark-throated Oriole <i>Oriolus xanthanatus</i>	NT	R	1,2,4,6–8,10,11,13	MDF,ker
Bar-bellied Cuckooshrike <i>Caracina striata</i>		R	2,12	MDF
Lesser Cuckooshrike <i>Caracina fimbriata</i>		R	1,2,4,7,8	MDF,Rip
Fiery Minivet <i>Pericratus igneus</i>	NT	R	2–4	MDF
Scarlet Minivet <i>Pericratus flammeus</i>		R	4,7	MDF,ker,Rip

Species ^{1,2}	CS ³	SS ⁴	Site ⁵	Habitat ⁶
Black-winged Flycatcher-shrike <i>Hemipus hirundinaceus</i>		R	1–6,8,10,11,13	MDF,ker,Rip,cl
Pied Fantail <i>Rhipidura javanica</i> (2)	P	R	5,9,11,13	MDF,Rip,cl
Spotted Fantail <i>Rhipidura perlata</i> (3)		R	1,2,4,6–9,12,13	MDF
Spangled Drongo <i>Dicrurus hattentattus</i>		W,P	2	MDF
Branzed Dranga <i>Dicrurus aeneus</i>		R	2,7,8,11,13	MDF,cl
Greater Racket-tailed Dranga <i>Dicrurus paradiseus</i>		R	1–6,8,11–13	MDF,ker,Rip,cl
Black-naped Monarch <i>Hypathymis azurea</i> (2)		R	1–4,6–9,11–13	MDF,ker,Rip,cl
Asian Paradise-flycatcher <i>Terpsiphane paradisi</i> (3)		R	1–4,7,8	MDF,ker
Common Iora <i>Aegithina tiphia</i>		R	[5],11	Rip,cl
Green Iora <i>Aegithina viridissima</i>	NT	R	1–13	MDF,ker,Rip,cl
Rufous-winged Philentoma <i>Philentama pyrhapterum</i> (9)		R	1,2,4,6	MDF,ker
Maroon-breasted Philentoma <i>Philentama velatum</i>	NT	R	[2],4	MDF
Large Woodshrike <i>Tephrodarnis gularis</i>		R	4,6,7,10	MDF,Rip
Grey-chested Jungle Flycatcher <i>Rhinomyias umbratilis</i> (22)	NT	R	1–8,10–13	MDF,ker,Rip
Dark-sided Flycatcher <i>Muscicapa sibirica</i> (1)		W,P	4,7,8	MDF
Asian Brown Flycatcher <i>Muscicapa dauurica</i> (2)		R,W,P	1–4,6,10	MDF,cl
Narcissus Flycatcher <i>Ficedula narcissina</i>		W	4	ker
Rufous-chested Flycatcher <i>Ficedula dumetaria</i> (1)	NT	R	9	MDF
[White-tailed Flycatcher <i>Cyarnis cancretus</i>]		W	[5]	MDF
Bornean Blue Flycatcher <i>Cyarnis superbus</i> (3)		R	1,6,7,9	MDF
Malaysian Blue Flycatcher <i>Cyarnis turcasus</i>	NT	R	11	Rip
Grey-headed Canary Flycatcher <i>Culicicapa ceylanensis</i>		R	1–4,6–9	MDF,ker
Oriental Magpie Robin <i>Capsychus saularis</i>		R	4–7,9,11,13	MDF,cl
White-rumped Shama <i>Capsychus malabaricus</i> (5)		R	1,2,4–9,11–13	MDF,ker,Rip,cl
Rufous-tailed Shama <i>Trichixas pyrrapyga</i> (6)	NT	R	2–6,9,11–13	MDF,ker,Rip
Chestnut-naped Forktail <i>Enicurus ruficapillus</i> (1)	NT	R	6	ker(Rip)
White-crowned Forktail <i>Enicurus leschenaulti</i> (1)		R	1	
White-vented Myna <i>Acridatheres cinereus</i>		R	11	cl
Hill Myna <i>Gracula religiosa</i>	P	R	2,4,6,9,11–13	MDF,ker,cl
Velvet-fronted Nuthatch <i>Sitta frontalis</i> (1)		R	1–4,6,10,11,13	MDF,ker
Barn Swallow <i>Hirunda rustica</i>		W	5	cl
Pacific Swallow <i>Hirunda tahitica</i>		R	4,5,7,9,11–13	MDF,Rip,cl
Black-and-white Bulbul <i>Pycnanatus melanaleucas</i> (1)	NT	R	2,4–6,9,10	MDF,ker,cl
Black-headed Bulbul <i>Pycnanatus atriceps</i> (3)		R	5,7–9,11,13	MDF,Rip,cl
Grey-bellied Bulbul <i>Pycnanatus cyaniventris</i>	NT	R	1–4,7,9	MDF
Puff-backed Bulbul <i>Pycnanatus eutilatus</i>	NT	R	2–13	MDF,ker,Rip,cl
Yellow-vented Bulbul <i>Pycnanatus gaiavier</i>		R	5,9,11,13	cl
Olive-winged Bulbul <i>Pycnanatus plumasus</i> (4)		R	5,8–13	MDF,ker,Rip,cl
Cream-vented Bulbul <i>Pycnanatus simplex</i> (10)		R	1–4,6,7,[8],9,10	MDF,ker,Rip,cl
Red-eyed Bulbul <i>Pycnanatus brunneus</i> (3)		R	5,[8],[10],11–13	MDF,Rip,cl
Spectacled Bulbul <i>Pycnanatus erythrophthalmus</i>		R	5,7,9,13	MDF,cl
Finsch's Bulbul <i>Alaphaixus finschii</i> (5)	NT	R	4,7	MDF
[Ochraceous Bulbul <i>Alaphaixus ochraceus</i>]		R	6	MDF
Grey-cheeked Bulbul <i>Alaphaixus bres</i> (5)		R	1–4,7–10,12	MDF,ker
Yellow-bellied Bulbul <i>Alaphaixus phaeocephalus</i> (13)		R	1–4,7–9	MDF
Hook-billed Bulbul <i>Setarnis criniger</i>	VU	R	2	ker
Hairy-backed Bulbul <i>Tricholestes criniger</i> (21)		R	1–4,6–10,12,13	MDF,ker

Species ^{1,2}	CS ³	SS ⁴	Site ⁵	Habitat ⁶
Buff-vented Bulbul <i>Iale alivacea</i>	NT	R	4,5,7,8	MDF, <i>ker</i> ,cl
Streaked Bulbul <i>Ixos moluccensis</i>	NT	R	3,4,10	MDF, <i>ker</i>
Yellow-bellied Prinia <i>Prinio floiventris</i>		R	4,5,7–9,11–13	MDF,cl
Oriental/Everett's White-eye <i>Zosterops polpebrosus/everetti</i>		R	7,10	MDF
Dark-necked Tailorbird <i>Orthotomus atragularis</i> (3)		R	1–13	MDF, <i>ker</i> ,Rip,cl
Rufous-tailed Tailorbird <i>Orthotomus sericeus</i> (7)		R	1,2,4–13	MDF, <i>ker</i> ,Rip,cl
Ashy Tailorbird <i>Orthotomus ruficeps</i>		R	2,5,7,10–13	MDF, <i>ker</i> ,Rip,cl
Arctic Warbler <i>Phyllascapus borealis</i> (2)		W,P	1,2,5,7,8	MDF,cl
Yellow-bellied Warbler <i>Abroscopus superciliaris</i>		R	11,13	MDF,Rip,cl
White-chested Babbler <i>Trichostomo rostratum</i> (11)	NT	R	1,2,5–9,11–13	MDF,Rip
Ferruginous Babbler <i>Trichostomo bicolor</i> (7)		R	1,2,4–9,11–13	MDF, <i>ker</i> ,Rip
Horsfield's Babbler <i>Malacocincla sepiarium</i> (6)		R	2,4,12	MDF
Short-tailed Babbler <i>Molococincla malaccensis</i> (23)	NT	R	1,2,4,5,7–9,11,12	MDF, <i>ker</i> ,Rip,cl
Black-capped Babbler <i>Pellarneau capistratum</i> (5)		R	1,[2],4,6,7,11–13	MDF, <i>ker</i>
Moustached Babbler <i>Molocopteron mognirostre</i> (10)		R	2–9	MDF,Rip,cl
Sooty-capped Babbler <i>Molocopteron offine</i>	NT	R	2,4,7–9,13	MDF, <i>ker</i>
Scaly-crowned Babbler <i>Molocopteron cinereum</i> (32)		R	1–4,6,8,9,12	MDF, <i>ker</i>
Rufous-crowned Babbler <i>Molocopteron mognum</i> (6)	NT	R	1–13	MDF, <i>ker</i> ,Rip,cl
Grey-breasted Babbler <i>Malacopteron albagulare</i> (19)	NT	R	1–4,6	MDF, <i>ker</i>
Chestnut-backed Scimitar Babbler <i>Pamatarhinus mantanus</i> (1)		R	1–4,6–8,12	MDF, <i>ker</i>
Bornean Wren Babbler <i>Ptilacichla leucagrammica</i>	VU	R	2,6	MDF
Striped Wren Babbler <i>Kenopio strioto</i> (1)	NT	R	1	Rip
Black-throated Wren Babbler <i>Napathera atrigularis</i>	NT	R	5	Rip
[Eyebrowed Wren Babbler <i>Nopothero epilepidoto</i>]		R	[4]	MDF
Rufous-fronted Babbler <i>Stachyris rufifrans</i>		R	2–4,6–10,12	MDF, <i>ker</i> ,Rip
Grey-headed Babbler <i>Stachyris poliocephala</i> (3)		R	7,9	MDF,Rip
Black-throated Babbler <i>Stachyris nigricalis</i> (8)	NT	R	1–4,6,10,11	MDF,Rip
Chestnut-rumped Babbler <i>Stachyris maculate</i> (5)	NT	R	1–4,6–12	MDF, <i>ker</i> ,Rip,cl
Chestnut-winged Babbler <i>Stochyris erythroptero</i> (19)		R	1–13	MDF, <i>ker</i> ,Rip,cl
Striped Tit Babbler <i>Macrauaus gularis</i> (4)		R	3–7,9–13	MDF, <i>ker</i> ,cl
Fluffy-backed Tit Babbler <i>Mocronous ptilosus</i> (8)	NT	R	2–4,6–13	MDF,Rip,cl
Brown Fulvetta <i>Alcippe brunneicauda</i> (4)	NT	R	1–13	MDF, <i>ker</i> ,Rip,cl
White-bellied Yuhina <i>Yuhino zantholeuco</i>		R	1,2,6,7	MDF
Yellow-breasted Flowerpecker <i>Prianachilus maculatus</i> (28)		R	1,2,3–10,13	MDF, <i>ker</i> ,Rip,cl
Yellow-rumped Flowerpecker <i>Prianachilus xanthopygius</i> (1)		R	1–9,12	MDF, <i>ker</i> ,Rip,cl
Scarlet-breasted Flowerpecker <i>Prionochilus thorocicus</i>	NT	R	2–6,13	MDF, <i>ker</i> ,cl
Brown-backed Flowerpecker <i>Dicaeum everetti</i>	NT	R	7	Rip/cl
Yellow-vented Flowerpecker <i>Dicaeum chrysarrheum</i>		R	3	
Orange-bellied Flowerpecker <i>Dicoeum triganastigma</i> (2)		R	1–5,7–12	MDF, <i>ker</i> ,Rip,cl
Plain Flowerpecker <i>Dicoeum concolor</i>		R	2–4,9,13	MDF,cl
Scarlet-backed Flowerpecker <i>Dicaeum cruentatum</i> (1)		R	5,11,12	<i>ker</i> ,cl
Plain Sunbird <i>Anthreptes simplex</i> (2)	P	R	1–5,7	MDF,cl
Brown-throated Sunbird <i>Anthreptes malocensis</i> [*]	P	R	4,5,7,9,11,12	MDF,cl
Ruby-cheeked Sunbird <i>Anthreptes singolensis</i> (4)	P	R	1–4,6,9,11–13	MDF,Rip,cl
Purple-naped Sunbird <i>Hypogrommo hypogrammicum</i> (5)	P	R	1,2,4–6,9,11,13	MDF, <i>ker</i> ,Rip,cl
Purple-throated Sunbird <i>Nectarinia sperata</i>	P	R	2–6	MDF, <i>ker</i> ,cl
Olive-backed Sunbird <i>Nectarinio juguloris</i>	P	R	13	cl

Species ^{1,2}	CS ³	SS ⁴	Site ⁵	Habitat ⁶
Crimson Sunbird <i>Aethopyga siparaja</i> (1)	P	R	5,9,11,13	MDF,Rip,cl
Temminck's Sunbird <i>Aethopyga temminckii</i>	P	R	1,2	
Little Spiderhunter <i>Arachnothera langirastra</i> (37)	P	R	1–9,11–13	MDF,ker,Rip,cl
[Thick-billed Spiderhunter <i>Arachnothera crassirostris</i>]	P	R	[13]	MDF
Long-billed Spiderhunter <i>Arachnothera rabusta</i>	P	R	1,2,4,8,[10]	MDF
Spectacled Spiderhunter <i>Arachnothera flavigaster</i>	P	R	4,6,10–12	MDF,ker
Yellow-eared Spiderhunter <i>Arachnothera chrysagenys</i>	P	R	1,3,4,9	MDF
Grey-breasted Spiderhunter <i>Arachnothera affinis</i>	P	R	7	MDF
Eurasian Tree Sparrow <i>Passer mantanus</i>		R	4,5,7,11	cl
Dusky Munia <i>Lanchura fuscans</i> (3)		R	2–5,7,9,11	cl
Black-headed Munia <i>Lanchura malacca</i>		R	5	cl

¹ Square brackets indicate species provisionally identified by the authors or species reported only by local informants. Of seven provisionally identified species, four were clearly of additional birds for the study (Japanese Sparrowhawk, Edible-/Black-nest Swiftlet, White-tailed Flycatcher, Oriental/Everett's White-eye). The remaining three may have been confused with other birds recorded due to uncertainty about calls (Barred Eagle/Brown Wood Owl, Ochraceous/e.g. Grey-cheeked Bulbul) or differences in juvenile plumage (Blyth's/Wallace's Hawk Eagle).

² Figures in brackets indicate the number of individuals captured in mist-nets.

³ International threat category and legal status in Indonesia. IUCN (2010) Red List categories: EN – Endangered, VU – Vulnerable, NT – Near Threatened. P – Protected under Indonesian law.

⁴ Seasonal status based on Mann (2008): R – Resident, W – Northern hemisphere winter visitor, Ws – Southern hemisphere winter visitor, P – Passage migrant, Mb – Breeding migrant.

⁵ Numeric site codes follow Figure 1 and Table 1. (L) – Denotes species reported present, or formerly present (L*), by local informants. Square brackets indicate provisional records.

⁶ Habitat codes follow categories described in Table 2. MDF – Mixed dipterocarp forest, Ker – Kerangas (heath forest), Rip – Riparian forest, cl – Converted lands.

Appendix 2

Species accounts: Near Threatened taxa

Unless otherwise stated, numbers of individuals recorded in specific habitats (described in the text or shown as figures in brackets) are taken from 2006 survey data.

Crested Partridge *Rollulus rouloul*

One recorded at Site 1 in 2000, another heard in moderately logged MDF at site 7b in 2006. The 'Siaw' (pron. *See-ow*) was well known to Dayak villagers throughout the study area, a number of whom suggested numbers may be falling in the area.

[Crested Fireback *Lophura ignita*

Not recorded directly during these surveys, Crested Fireback has been recorded previously at Barito Ulu (Wilkinson *et al.* 1991) and south of Tuhup (Voous 1961), and was recognised by villagers as occurring in the vicinity of Baloi, Tumeh and Dempar. A number of interviewees regarded male Crested and Crestless Firebacks as separate sexes of the same species.]

Great Argus *Argusianus argus*

The most commonly recorded pheasant due to its conspicuous and far-carrying call. Singles recorded at Sites 1 and 4 in 2000, and at least four individuals heard in MDF at Site 2 and near Site 4 in 2006. It was well known to hunters, who reported it present throughout most of the study area. However, birds were directly encountered only in the relatively intact and inaccessible forests of the north-west section.

Malaysian Honeyguide *Indicator archipelagicus*

A single bird mist-netted in disturbed riparian forest at Tuhup, with another remaining close by until its release. This is the second record from Central Kalimantan (Mann 2008).

Buff-necked Woodpecker *Meiglyptes tukki*

Five in 2006, including a pair captured in MDF at Site 4, a single captured in dense 3m *ladang* regrowth near Empakuq, and singles observed in undisturbed swamp forest near Empakuq and heavily logged forest at Site 12. A single bird was netted at Site 1 in 2000.

Red-crowned Barbet *Megalaima rafflesii*

Recorded at most sites and in a variety of habitats, including *kerangas* (9), logged MDF (16) and isolated fruiting trees in settled areas (e.g. Muara Tuhup).

Red-throated Barbet *Megalaima mystacophanos*

Recorded at most sites in the central west and eastern sections of the study area and at Tuhup, although scarce or absent from much of the north-west. Recorded in all habitat types but commonest in MDF (15). Only one was

heard in *kerangas* (Site 6), and none was heard in heavily logged MDF on low-nutrient soils at Site 12, suggesting this species may rely on more fertile soils for a higher density of fruiting trees than the Red-crowned Barbet, at least at the time of survey. Elsewhere somewhat tolerant of habitat disturbance, with birds heard in logged MDF, mature secondary forest and remnant MDF fragments.

Yellow-crowned Barbet *Megalaima henricii*

Recorded in MDF (24) at most sites (cf. Site 12). Tolerant of some habitat disturbance, with birds present in logged forest and remnant MDF patches adjacent to converted lands. A single heard in tall *kerangas* at Site 4.

Black Hornbill *Anthracoceros malayanus*

Recorded in moderately to heavily logged forests at Sites 9, 10 and 12, and in MDF and riparian forest at all sites in the north-west. A group of four observed in unlogged MDF at Site 2. Not detected in *kerangas*.

Rhinoceros Hornbill *Buceros rhinoceros*

Recorded in MDF (23) and riparian forest (1) at all sites except Site 10. Tolerant of some habitat disturbance, with birds recorded in remnant MDF fragments and emergent fruiting trees in logged forest and converted lands.

Helmeted Hornbill *Buceros vigil*

Singles recorded at Sites 1 and 4 in 2000. Eight recorded in 2006 in remnant MDF and emergent fruiting trees in logged forest at Sites 8, 9, 10 and at Dempar.

White-crowned Hornbill *Aceros comatus*

Heard in moderately logged MDF at Sites 7 and 12, and in a remnant MDF fragment in converted lands near Tuhup.

Wrinkled Hornbill *Aceros corrugatus*

Pairs seen flying over heavily logged forest at Site 8, and converted rural lands near Empakuq. Pairs of this species or Wreathed Hornbill *A. undulatus* seen flying over converted rural lands near Baloi and Dempar.

Red-naped Trogon *Harpactes kasumba*

Three in lightly logged forest at Site 1 and one at Site 2 in 2000. In 2006, a trogon heard briefly in logged forest at Site 8 was provisionally identified as this species.

Diard's Trogon *Harpactes diardii*

Singles recorded in lightly logged forest at Site 2 in 2000, and in 2006 in logged MDF at Sites 7, 8 and 12 and in secondary forest near the Mahakam River downstream from Empakuq.

Scarlet-rumped Trogon *Harpactes duvaucelii*

The most commonly encountered trogon. Present throughout the study area in primary and logged MDF (18), and recorded in *kerangas* (4) at Sites 3, 4 and 6.

Moustached Hawk Cuckoo *Hierococcyx vagans*

Singles heard in heavily logged MDF at Site 8 and from a distance in agricultural/secondary forest/ MDF mosaic near Dempar.

Black-bellied Malkoha *Phaenicophaeus diardi*

In 2006 singles seen in *kerangas* at Site 6 and on the edge of moderately logged MDF at Site 7, and a pair observed in lightly logged MDF at Site 2.

Chestnut-bellied Malkoha *Phaenicophaeus sumatranus*

In 2006 recorded in *kerangas* at Site 6 (group of 4), moderately logged MDF at Site 6 (1) and undisturbed swamp forest near Empakuq (1). In 2000 recorded three times in *kerangas* at Site 3 and once at Site 4.

[Bornean Ground Cuckoo *Carpococcyx radiatus*

A hunter interviewed at Dempar claimed this species occurs in remnant forest downstream and west of the Nyuatan River. Not recorded directly.]

Blue-rumped Parrot *Psittinus cyanurus*

Recorded in all sections of the study area (north-west, central west and east). Common near Site 8 with at least 18 birds observed in moderately logged MDF (12) and *kerangas* (6). Kept as pets by residents at Dempar.

Large Frogmouth *Batrachostomus auritus*

A Large Frogmouth responded to a call playback from a forested hill alongside a tributary of the Lampunut River south of Site 4. This is the second record from Central Kalimantan (Mann 2008).

Gould's Frogmouth *Batrachostomus stellatus*

A Gould's Frogmouth was heard over two nights in lightly logged MDF adjacent to the campsite at Site 2. This is the second record from East Kalimantan (Mann 2008).

Cinnamon-headed Green Pigeon *Treron fulvicollis*

At least eight observed with a similar number of Thick-billed Green Pigeons *T. curvirostra* feeding in the canopy of a fruiting tree at 16h00 in undisturbed swamp forest near Empakuq.

Jambu Fruit Dove *Ptilinopus jambu*

Singles in *kerangas* at Sites 3 and 4 in 2000. Not recorded in 2006, but recognised by villagers from Intu Lingau. Normally silent, it may be commoner than these numbers suggest. Mann (2008) listed no records from Central Kalimantan though it was recorded in low numbers at Barito Ulu (Wilkinson *et al.* 1991).

Grey-headed Fish Eagle *Ichthyophaga ichthyaeus*

One circling over the Nyuatan River downstream from Dempar in 2006.

Black-and-yellow Broadbill *Eurylaimus ochromalus*

Common throughout the study area, predominantly in lightly to heavily logged MDF (30+), though also recorded in riparian forest (4) and *kerangas* (3).

Green Broadbill *Calyptomena viridis*

Seen or heard at most sites (but not recorded in 2000) where it was most common in (lightly to heavily logged) MDF (12).

Lesser Green Leafbird *Chloropsis cyanopogon*

Common throughout the study area, predominantly in logged MDF (23), although also recorded in riparian forest (2), *kerangas* (6) and early stage secondary growth (5).

Crested Jay *Platylophus galericulatus*

Single birds recorded in primary MDF at Site 2 and in heavily logged MDF

at Site 8. Provisional records in MDF at Site 1 and a bird heard in *kerangas* at Site 6.

Black Magpie *Platysmurus leucopterus*

Common throughout the study area and recorded in a range of forest types, including lightly to heavily logged MDF (18), *kerangas* (4) and riparian forest (1).

Bornean Bristlehead *Pityriasis gymnocephala*

In 2000 two groups of four birds observed in *kerangas* at Site 3, and another group of four at Site 4. In 2006 two groups of at least four birds observed on the edge of heavily logged MDF at Sites 4 and 8, and two birds heard in lightly logged MDF at Site 2.

Dark-throated Oriole *Oriolus xanthonotus*

Recorded at most sites in lightly to heavily logged MDF (8), and once in a small area of *kerangas* within MDF matrix near Site 8 in 2006.

Fiery Minivet *Pericrocotus igneus*

In 2000 recorded at Sites 3 and 4, and in *Casuarina* trees in lightly logged MDF at Site 2. Not recorded in 2006.

Green Iora *Aegithina viridissima*

Seen or heard almost daily and at all sites. Recorded in primary and logged MDF (43) riparian forest (3), *kerangas* (3) and *ladang* regrowth (2).

Maroon-breasted Philentoma *Philentoma velatum*

A single male observed in *kerangas* at Site 4 in 2000.

Grey-chested Jungle Flycatcher *Rhinomyias umbratilis*

Common in less disturbed forests throughout the study area. Recorded in lightly to moderately logged MDF (12), *kerangas* (5) and riparian forest (3).

Rufous-chested Flycatcher *Ficedula dumetoria*

A male was mist-netted in moderately logged MDF at Site 9.

Malaysian Blue Flycatcher *Cyornis turcosus*

A male seen in undisturbed swamp forest near Empakuq in 2006.

Rufous-tailed Shama *Trichixos pyrropyga*

Present at most sites and in a variety of habitats, including *kerangas* (3), riparian forest (1) and lightly to moderately logged MDF (12).

Chestnut-naped Forktail *Enicurus ruficapillus*

One netted in streamside *kerangas* at Site 6 in 2006.

Black-and-white Bulbul *Pycnonotus melanoleucos*

Singles at Sites 2 and 4 in 2000. In 2006 recorded near Tuhup and at sites in the north-west and central west sections in logged MDF (5), *kerangas* (5) and secondary forest (1).

Grey-bellied Bulbul *Pycnonotus cyaniventris*

Recorded in primary and heavily logged MDF (10) at most sites in the north-west section and at Sites 7 and 9.

Puff-backed Bulbul *Pycnonotus eutilotus*

Present throughout the study area in a range of habitats, including logged MDF (23), riparian forest (2), *kerangas* (2) and secondary forest (5).

Finsch's Bulbul *Alophoixus finschii*

At Site 4, four birds seen and one netted in 2000 and two seen on the edge of moderately logged MDF in 2006. Two pairs netted in lightly logged MDF at Site 7 in 2006.

Buff-vented Bulbul *Iole olivacea*

In 2006 recorded in moderately to heavily logged MDF (3) at Sites 7 and 8, in *kerangas* (1) near Site 8 in 2006, and in *ladang* regrowth near Tuhup (1). Pairs observed twice in moderately logged MDF at Site 4 in 2000.

Streaked Bulbul *Ixos malaccensis*

Pairs twice at Site 3 and three times at Site 4 in 2000. In 2006 a single seen in tall *kerangas* near Site 4 and a pair observed in moderately logged MDF at Site 10.

White-chested Babbler *Trichastoma rostratum*

Common throughout the study area wherever waterside vegetation persists, including riparian forest (24) lining the larger rivers and swamps, and lightly to heavily logged MDF (13) around the smaller streams and marshes. Not recorded in *kerangas*.

Short-tailed Babbler *Malacocincla malaccensis*

Fairly common throughout the study area. In 2000 two mist-netted in MDF at Site 1, four at Site 2 and two in *kerangas* at Site 4. In 2006 recorded mostly in lightly to moderately logged MDF (10) and riparian forest (7), with singles in tall *kerangas* at Site 4 and secondary forest planted with rubber near Tuhup.

Sooty-capped Babbler *Malacopteron affine*

Recorded at scattered localities in all sections of the study area, with the highest numbers at Sites 7 (4) and 8 (5) in the central west. In 2006 found in lightly logged MDF (6) and moderately to heavily logged MDF on volcanic soils (8). One in tall *kerangas* at Site 4 in 2000.

Rufous-crowned Babbler *Malacopteron magnum*

The most commonly recorded tree-babbler. Found at all sites and in a variety of habitats, including lightly to heavily logged MDF (40), riparian forest (2), moderate-height and tall *kerangas* (7) and secondary forest (2).

Grey-breasted Babbler *Malacopteron albogulare*

Consistent with a preference for intact, low-productivity forest (Sheldon 1987, Holmes & Wall 1989, Dutson *et al.* 1991), this species was recorded only in the north-west section of the study area where it was found at all sites. Located by mist-netting only and often captured in pairs or groups. At Site 2, five birds (2, 2, 1) captured in lightly logged MDF in 2000, and one in 2006. In *kerangas* at Sites 3 and 4, five birds (3 and 2 respectively) captured in 2000, and one in 2006. One bird captured at Site 1 in logged MDF in 2000; and in *kerangas* at Site 6, three birds captured together in 2006.

Striped Wren Babbler *Kenopia striata*

One mist-netted in riverine forest at Site 1 in 2000. Not recorded in 2006.

Black-throated Wren Babbler *Napothera atrigularis*

In 2006 a single bird was heard and taped in riparian forest near Tuhup. This is the first from Central Kalimantan (Mann 2008).

Black-throated Babbler *Stachyris nigricollis*

In 2000 mist-netted in *kerangas* (3) and lightly logged MDF (7). In 2006 recorded in unlogged riparian swamp forest near Empakuq (2), and in lightly logged (3) and moderately logged MDF (2), and in heavily disturbed MDF on waterlogged soils (7).

Chestnut-rumped Babbler *Stachyris maculata*

Present at most sites throughout the study area. In 2006 recorded in riparian forest (1), moderate-height and tall *kerangas* (6), lightly logged (6), moderately logged (9) and heavily logged MDF (11) and secondary growth (6).

Fluffy-backed Tit Babbler *Macronous ptilosus*

Recorded at most sites and tolerant of disturbed habitats. In 2006 recorded in riparian forest (2), lightly to moderately logged (6) and heavily logged MDF (6), and *ladang* regrowth, early successional regenerating MDF and secondary forest (11). In 2000 birds mist-netted in roadside coral ferns at Site 3 (2) and noted <2 m from creekside vegetation at Site 2. Not recorded in *kerangas*.

Brown Fulvetta *Alcippe brunneicauda*

Recorded at all sites. Tolerant of moderate habitat disturbance but most numerous in less disturbed forests. In 2006 recorded in riparian forest (7), moderate-height and tall *kerangas* (5), secondary forest (1) and lightly to moderately logged (30) and heavily logged MDF (12). In 2000 most abundant at Sites 2 and 4.

Scarlet-breasted Flowerpecker *Prionochilus thoracicus*

Uncommon outside the north-west section where it was recorded at most sites in both years. In 2006 recorded in *kerangas* (5), lightly to moderately logged MDF (2), *ladang* regrowth (1) and rubber *kebun*/secondary forest (2).

Brown-backed Flowerpecker *Dicaeum everetti*

In 2006 a single observed at Site 7 taking fruit from *Melastoma polyanthum* shrubs growing on the banks of a small river adjacent to the main camp clearing. Intact riparian forest and lightly logged MDF dominated the steep slope on the opposite bank. This is the first record from Central Kalimantan (Mann 2008).